SCALE INSECTS AND THEIR *Control*

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Scale insects are numbered among the most important pests of plants. They occur on shade and ornamental trees, fruit trees, greenhouse and house plants. Damage caused by them is usually serious, especially when their presence is not recognized until the population is heavy and advanced symptoms of injury begin to show. By this time it may be too late to prevent the loss of part or all of the plants attacked.

When treatment is neglected, or when the insecticides used for control are inadequate or poorly timed, losses may amount to many thousands of dollars annually. Furthermore, the possibility of plant injury by dormant spray oils when used on evergreens plus the risk of destroying the bloom on certain varieties has in some instances resulted in delaying, and sometimes abandoning treatment. Besides dormant oil sprays, nicotine sulphate and soap have been used quite commonly for control of the crawling stages of scale insects.

Standard control measures have not been as effective as they should be. However, the development of new insecticides has offered the possibility of more efficient control with fewer treatments a season. Furthermore, there is much less risk of injuring plants with the newer materials. These new materials have been tested here for the past several years and results are reported in this bulletin.

Because of their small size, some species of scale insects may be overlooked unless one is reasonably familiar with their habits and general appearance. Hence it is important that scale insects be correctly identified and their habits understood before the problem of control is undertaken.

In the following pages a brief description of the general appearance and habits of several important species is given. These include Arborvitae soft scale *Lecanium fletcheri* (F.), the soft brown scale of greenhouse plants *Coccus hesperidum* (L.), the Euonymus scale *Unaspis euonymi* (Comst.), the Cottony-Taxus scale *Pulvinaria floccifera* (W.), the Oystershell scale *Lepidosaphes ulmi* (L.), the Pine leaf scale *Phenacaspis pinifoliae* (Fitch), the Azalea bark scale *Eriococcus azaleae* (Comst.) and mealybugs. Control measures for each of these species, based upon the results of our experiments, are also given.

EXPERIMENTAL MATERIALS AND METHODS

The experiments were carried on from 1949 to 1953 inclusive. Insecticides used were of several types. Chlorinated hydrocarbons tested were DDT, chlordane, aldrin, dieldrin and lindane emulsions, aldrin wettable powder, and DDT and chlordane dusts. The organic phosphates included TEPP, parathion, *Potasan, Systox, Pestox,* and

malathion emulsions; malathion dust and parathion wettable powder were also tried. In addition, the organic thiocyanate *Loro* and nicotine sulphate liquid and dust were used. A selenophosphate emulsion and a white summer oil emulsion completed the list of insecticides tested.

Experimental treatments were applied to plants in the field, greenhouse and laboratory. In the latter two instances many small plants could be handled more effectively under controlled conditions than plants in nursery rows. When possible, results obtained in the laboratory and greenhouse were rechecked in the field.

Sprays were applied by means of a 300-gallon hydraulic sprayer, a 10-quart wheelbarrow mist blower, and a 3-gallon hand-operated pressure sprayer. In addition, a 17-inch hand duster was used to apply the wettable powders as dusts, as well as standard dust formulations.

ARBORVITAE SOFT SCALE

Life History

The species of the genus *Lecanium* to which the aborvitae soft scale belongs occur abundantly everywhere. They attack all kinds of plants both in conservatories and out-of-doors. Some of them are known as

Figure 1. Lecanium Scale on *Taxus hatfieldi*. This photograph and others appearing in this bulletin were taken by B. W. McFarland.

"soft scales". The scientific name *Lecanium*, however, is becoming familiar to all. For years *Lecanium fletcheri* was found on Arborvitae almost exclusively where for the most part damage appeared to be of minor concern. Within recent years, however, the species has turned up on Taxus (Yew). The increase in population has been enormous, with *T. hatfieldi* and *T. brevifolia* listed among the most favored hosts. Observations in 1953 would indicate that the species occurs also on Pachysandra. When branches and the underside of the foliage are covered with scales, serious weakening of the plant may occur. Taxus needles may lose color and drop prematurely. The scales secrete honeydew in which sooty fungus grows, causing an unsightly blackening of affected plants.

The scale as it is seen on a plant is the naked body of the insect. The species is flat in general appearance, particularly so in its early stages of development. It is more or less hemispherical in outline. The mature scale is dark brown in color. However, newly hatched young have a delicate amber or paraffin-like color. As they grow, the color changes to pale orange-yellow.

There is only one brood a year out-of-doors in Connecticut. The eggs are deposited beneath the body of the female. Initial hatch may vary with temperature conditions from year to year. The earliest has been June 11 and the latest June 23. Hatching may continue for two to four weeks. Development is almost negligible during the summer and fall. Overwintering occurs as a very small, soft scale on the stems, branches and underside of the leaves (rarely on the upper surface, especially in the case of Taxus). When temperature is right in April of the following year, feeding is resumed and the scales mature rapidly. By May 25, seventy-five per cent or more of the female scales examined contained eggs. Counts would indicate an average of 468, a maximum of 1118 and a minimum of 178 eggs per female.

Control Experiments

Preliminary Tests

The first experiments were undertaken in late June, 1950, shortly after the young started hatching with an estimated 7 to 10 per cent dispersal. Twelve *Taxus hatfieldi* trees badly infested with *Lecanium* were used. Materials and dilutions appear in Table 1. A 3-gallon hand-operated pressure sprayer and small hand duster were used to make the treatments. Data on control was obtained by examining all of the scales on eight 4-inch twigs (average) under a low power binocular microscope. In addition, cardboard was placed under the trees to catch dead young as they loosed their grip on being killed and fell from the plants.

The spray materials used (Table 1) killed young (crawling) scales when the treatments were applied. Many of the dead scales dropped from the trees and consequently did not appear on the plants when the control data were taken in mid-July. The dislodgment of dead

scales seemed to be more rapid and more complete on the TEPP-treated trees. On the other hand, a large percentage of the scales adhered for a long while to the plants treated with *Loro* and white summer oil. At the time of treatment TEPP killed faster than the other insecticides. During the following two days, however, newly emerging young were killed by parathion residue, whereas they survived on the TEPP-treated trees. This is due to the negligible residual action of the latter insecticide in contrast to parathion.

TABLE 1. CONTROL OF LECANIUM SCALE, JUNE, 1950

Treatment	Dilution	Control Mid-July	
		Alive	Dead
TEPP			
40% emulsion	1-800	many	dislodged
40% emulsion	1-1600	many	dislodged
Parathion			
15% wettable powder	5 lbs. per	24	250+
15% wettable powder	100 gal. water		
Chlordane			
48% emulsion	1-200	300+	200+
5% dust	light dusting	71	200+
5% dust	heavy dusting	33	200+
Aldrin			
25% emulsion	1-200	27	30
25% wettable powder	light dusting	22	35
Dieldrin			
24% emulsion	1-200	8	50+
White summer oil			
97% emulsion	1-25	7	50+
Loro			
40% emulsion	1-200	6	300+
Loro			
40% emulsion plus	1-200	0	200+
40% nicotine sulphate	1-800		

After 24 hours exposure, chlordane, aldrin and dieldrin (residue) had very little effect on newly emerging young. Mortality was slow and incomplete. By the end of a week the plants treated with these materials, as well as those treated with TEPP, parathion and white summer oil were repopulated with live young scales.

Scales were killed quickly with *Loro* and *Loro* plus nicotine sulphate. On the day following treatment the plants seemed to be covered with dead scales. These adhered to the plants for some time. An examination of the young that had not dispersed from under the parent scales showed all to be dead on the *Loro* plus nicotine sulphate-treated tree and 90 per cent dead on the *Loro*-treated tree. It was seen at the time of final examination in mid-July that many of the eggs had been

destroyed by the *Loro* treatment and almost all by the *Loro* plus nicotine sulphate treatment.

In addition to the foregoing experiment, 40 per cent nicotine sulphate was used in dosage series of 1 to 100, 200 and 400 on *T. hatfieldi* infested with young scales. Results 10 days after treatment indicated that all of the scales were dead at all dilutions. At this time unsprayed plants were covered with innumerable healthy scales.

In late June 20 per cent TEPP emulsion at the rate of 1 to 1600 was applied to a quarter acre of scale-infested *T. brevifolia*. The treatment was repeated twice at 12-day intervals. A 300-gallon hydraulic sprayer was used. During the last week in July five 8 to 12-inch branches were taken from each of five trees in the block. With the aid of a low power binocular microscope 660 scales were examined, all of which were dead. Unsprayed plants were heavily infested with live scales. Because of their great numbers, counts were not made.

DDT Treatments

Portions of three-foot *Taxus hatfieldi* infested with *Lecanium* scale were sprayed in early May with DDT 25 per cent emulsion in dosage series of 1 to 200, 400, 800, and 1600. A small hand-operated sprayer was used to apply the treatments. Results are tabulated in Table 2.

TABLE 2. CONTROL OF LECANIUM SCALE WITH DDT

Material	Dilution	Control May 22		Per Cent Control
		Alive	Dead	
DDT 25% emulsion	1-200	7	162	95.8
	1-400	2	141	98.6
	1-800	56	8	12.5
	1-1600	42	4	8.6
Untreated		200+		

Results of the DDT treatments show the insecticide to be effective (at concentrations of 1 to 400 and greater) when applied to maturing scales before the armor hardened and egg laying began. Scales in advanced stages of development are much less apt to fall from a plant than young scales when killed by an insecticide. Hence the number of dead scales tabulated in Table 2 is probably correct.

Tests with Malathion and Parathion

In late winter 8-inch cuttings of Arborvitae infested with *Lecanium* scale were treated in a propagating bench with malathion 57 per cent and parathion 25 per cent emulsions at dosages of 1 to 100 and 1 to 200. *Triton B-1956* used at the rate of 1 to 800 was added to the spray mixtures as an additional spreading and sticking agent. A 3-gallon hand pressure sprayer was used to make the treatments.

Results showed that both insecticides at two dilutions destroyed all of the scales on the Arborvitae cuttings. Many of the female scales contained eggs, some of which had hatched. The dispersed young were included with the adults in making counts of dead scales. All young scales present under the female scale were dead but counts were not made.

In the nursery, two 30 to 36-inch scale-infested globe Arborvitae and two 36-inch pyramid Arborvitae were sprayed with malathion 57 per cent emulsion and parathion 25 per cent emulsion at dosages of 1 to 200 and 1 to 400. *Triton B-1956* used at the rate of 1 to 400 was added to the sprays for additional spreading and sticking action. A 3-gallon hand pressure sprayer was used to make the treatments.

Results indicate that malathion and parathion applied to *Lecanium* scale in late May, when many of the female scales contained eggs, destroyed the adult population. Moreover, eggs, and young that had not left the protection of the parent scale, were also killed by both insecticides at both dilutions. The treatments did not injure the plants.

Six globe Arborvitae 30 to 36 inches high were dusted with 5 per cent malathion dust in mid-summer. Three plants received a light treatment and three a heavy one. An additional six plants were held as checks. The treatments were made by means of a small hand duster. One month after treatment six 6 to 8-inch twigs from each of the treated and check plants were examined by means of a low power binocular microscope. The results are tabulated in Table 3.

Table 3. Control Of Lecanium Scale In Mid-summer With Malathion Dust

Material	Dilution	Control Sept. 3	
		Dead	Alive
Malathion 5% dust	light dusting	682	1
	heavy dusting	920	0
Untreated		324	458

When malathion 5 per cent dust was used in light and heavy applications, reduction in scale population was excellent. All scales at the time of treatment were in the immature stage. The large number of dead scales on the untreated plants could not be accounted for. Under most conditions natural mortality is not great once the young scales have settled down for hibernation. Parasitism was entirely absent.

Systemic Insecticides

Six 25 to 30-inch *T. hatfieldi,* heavily populated with immature overwintering *Lecanium* scales, were brought into a greenhouse for treatment. Five weeks later one-half of each of two of the trees was sprayed with the systemic compound *Systox* emulsion (30.2 per cent) in dosages

of 1 to 50 and 1 to 100. Four ounces of spray were used per tree. Two of the remaining trees were treated by applying *Systox* as a soil drench at the rate of 1 to 50 and 1 to 100. Two quarts of solution were used per tree. One-half of the fifth tree was sprayed with four ounces of a spray containing 30.2 per cent selenophosphate systemic emulsion at the rate of 1 to 200. All treatments were repeated in eight weeks. The sixth tree received no treatment. Burlap was used to protect the unsprayed half of a tree and the soil while treatment was being applied. Table 4 gives the results of both treatments. Control data were taken from four branches (averaging 12 inches in length) per tree.

TABLE 4. CONTROL OF LECANIUM SCALE IN THE GREENHOUSE WITH SYSTEMICS, DECEMBER, 1950

Material	Dilution	Scale Mortality					
		March 7[1]			April 19		
		dead	alive	control	dead	alive	control
Systox 30.2% emulsion	1-50 foliage spray	0	180	0	25	0	100
	1-100 foliage spray	0	165	0	16	1	94.2
	1-50 soil drench	0	9	0	2	0	100
	1-100 soil drench	0	37	0	1	2	33.3[2]
Selenophosphate 30.2% emulsion	1-200 foliage spray	0	28	0	2	7	22.2[2]
Untreated		5	279		3	308	

[1]Second treatment followed counts made on March 7.
[2]Based on counts. If calculated on the basis of untreated plants, control would be much higher.

Results show that two treatments were necessary for good control. Because of the fact that many of the scales killed by the spray treatments dropped from the plants, the data on number of dead scales recorded is misleading. Some of the more mature scales killed by the second treatment remained on the plants.

In a second experiment, *Taxus hatfieldi* heavily infested with *Lecanium* were sprayed in a nursery row during the first week of April, with *Loro* 40 per cent, *Systox* 30.2 per cent, *Pestox* 65 per cent, *Potasan* 30.6 per cent, and selenophosphate 30.2 per cent in dosage series of 1 to 50, 100 and 200. About 2 quarts of spray were used per plant. A 3-gallon hand pressure sprayer was used to apply the treatments. Data on control were taken from one 18-inch twig per plant. The side branches from each twig were examined separately with the aid of a low power binocular microscope.

Results of the tests indicate that the treatments were high in efficiency in destroying the scales. With the exception of *Pestox*, which gave a kill of 86, 32, and 2 per cent for the three dilutions of 1 to 50, 100, and 200 respectively, scales did not survive treatments with the other four insecticides at any dilution. By contrast, there were 318

live scales and 7 dead ones on the untreated plant. Dead scales dropped from all of the treated plants.

Phytotoxicity induced by selenophosphate was serious at the highest concentrations used in the greenhouse. In the nursery this material damaged *Taxus hatfieldi* badly at 1 to 50; much less so at 1 to 100, and apparently not at all at 1 to 200. None of the other systemics, however, appeared to injure Taxus foliage. The trees treated with all five materials at 1 to 50 showed some delay in the development or actual injury to new buds. At the 1 to 100 dilutions the condition was much less obvious, and at 1 to 200 not at all, or almost negligible.

THE SOFT BROWN SCALE AND OTHER GREENHOUSE SPECIES

Life History

The soft brown scale *Coccus hesperidum* (L.) occurs commonly on greenhouse and house plants. It attacks a wide variety of plants[1] such as ferns, palms, ficus plants, ivy and other ornamentals. In addition

Figure 2. Soft Brown Scale on English Ivy

to this species, the hemispherical scale *Saissetia hemisphaerica* Targ., the common fern scale *Hemichionaspis aspidistrae* Sign. and the Camellia scale *Lepidosaphes Camelliae* Hoke, are found more or less abundantly in the greenhouse.

[1]COMPTON, C. C. Greenhouse Pests. Ill. State Nat. Hist. Surv., Ent. Ser. Circ. No. 12:122. 1930.

The soft brown scale, or tortoise scale, as it is sometimes called, is flat and fleshy. It is oval in outline, and light brown or greenish-brown in color, sometimes blending with the color of the foliage on which it occurs. The males are white, elongated, and readily seen on the part of the plant on which they are resting. The females give birth to live young, one or two being born daily for a month or two.[1] The young are sluggish, and settle down mostly near the parent, completing development in about two months.

The hemispherical scale is convex and strongly elliptical, smooth and dark brown. It is also larger than other scales found on ferns. Eggs are laid under the female scale, and the young stay within the near vicinity of the parent, maturing very slowly. There are perhaps not more than two generations a year.

The common fern scale is a very small species. It occurs on the underside of leaves. Because of their very light brown or greenish-brown color, they are hard to see. Young disperse from the parent scale to a suitable place where they settle down and feed, remaining for the most part in this position for the balance of their life.

The Camellia scale is distinguished from other scales by the somewhat pear-shaped, flattened and dark brown color of the female scale. There is another species of scale which occurs on Camellia and is sometimes called the Camellia scale. Scientifically it is known as *Fiorinia floriniae* Targ.[2] This species is flat with a wrinkled surface and a prominent median line on its back.

Earlier Methods of Control

Inasmuch as scales do best in the greenhouse when the atmosphere is dry, plenty of moisture was maintained at all times. Removal and burning of badly infested leaves has been practiced. When only a few leaves were infested, the scales were wiped off with a soft cloth. Drenching the plants with 40 per cent nicotine sulphate has given good control. Fumigation with hydrocyanic acid gas, nicotine, carbon bisulfide and sulfur has also been practiced successfully.

Control Experiments

The first greenhouse experiments were carried on to control a species of scale, *Coccus hesperidum* (L.) on Camellia with systemics. During the winter of 1951 twelve 3-foot Camellias planted in 12-inch pots were treated with a soil drench of *Pestox* 65 per cent, *Systox* 30.2 per cent, and selenophosphate 30.2 per cent emulsions in dosage series of 1 to 50, 100, and 200. Each treatment consisted of 32 ounces of solution per pot. In addition three 5 to 6-foot Camellia plants were sprayed with *Potasan* 30.6 per cent emulsion in dosage series of 1 to 200, 400, and 800. A 3-gallon hand-operated pressure sprayer was used for the

[1]METCALF, C. L., AND W. P. FLINT. Destructive and Useful Insects, Third Edit. rev. 1951.
[2]COMPTON, C. C. Greenhouse Pests, Ill. State Nat. Hist. Surv., Ent. Ser. Circ. No. 12:112. 1930.

purpose. Data were taken from five to ten leaves picked from the treated and check plants. All scales were examined with the aid of a low power binocular microscope. Results appear in Table 5.

Table 5. Control Of Camellia Scale With Systemics

Material	Dilution	Scale Control, 4 to 8 Weeks		Per Cent Control
		Dead	Alive	
Pestox				
65% emulsion	1-50	88	38	69.8
as soil drench	1-100	19	11	63.3
	1-200[1]			
	1-400	192	94	67.0
Systox				
30.2% emulsion	1-50	5	6	45.4
as soil drench	1-100	9	15	37.5
	1-200	2	1	66.0
Selenophosphate				
30.2% emulsion	1-50[2]	0	0	
as soil drench	1-100	3	10	23.0
	1-200	0	6	0.0
Potasan				
30.6% emulsion	1-100	76	3	96.2
as foliage spray	1-200	329	44	88.2
	1-400	121	75	61.7
	1-800	177	71	71.3
Untreated		23	82	

[1]Data incomplete.
[2]Plant died from treatment.

It can be seen in Table 5 that *Potasan* as a foliage spray gave the best control of Camellia scale. *Pestox* as a soil drench at all dilutions gave fairly good control, with *Systox* not so good and selenophosphate showing up very poorly. The latter material caused serious chlorosis in Camellia foliage. Seventy-five per cent of the leaves of the plant treated at 1 to 50 turned completely yellow and dropped prematurely. The plant died before control data could be taken. The foliage on the remaining two plants treated with this systemic revealed some chlorotic symptoms.

Control of Scale on Stephanotis

The soft brown scale *Coccus hesperidum* (L.) is a serious pest of Stephanotis in greenhouses where the plant is grown for its flowers and foliage. Experiments were carried on during the winter of 1951. The systemic compounds *Systox* 30.2 per cent, *Pestox* 65 per cent, and selenophosphate 30.2 per cent emulsions were applied as soil drenches in dosage series of 1 to 50, 100, and 200 to vines growing in a greenhouse bench. Each plant received 1 quart of solution. Control data

were taken five weeks after treatment by examining all of the scales on seven leaves picked at random from each treated vine and check vine.

Results of the experiment appear in Table 6.

TABLE 6. CONTROL OF SCALE ON STEPHANOTIS WITH SYSTEMICS (SOIL TREATMENTS)

Material	Dilution	Control in 5 to 7 weeks		Per Cent Control
		Dead	Alive	
Systox				
30.2% emulsion	1-50	49	97	33.5
	1-100	8	150	5.0
	1-200	48	155	23.6
Pestox				
65% emulsion	1-50	63	209	23.1
Selenophosphate				
30.2% emulsion	1-50	51	138	26.9
	1-100	138	566	19.6
	1-200	115	355	24.4
Untreated		7	132	

Control of scale on Stephanotis was erratic and poor (Table 6). None of the materials used as soil drenches in the tests showed much promise for the purpose intended. Two weeks after treatment the plants that had received selenophosphate at 1 to 50 and 1 to 100 showed serious symptoms of chlorosis. The leaves on the lower part of the vines were completely yellowed and dropping. Some of the leaves on the upper part of the vines could be shaken loose with little difficulty. The vines treated with this compound at 1 to 200 appeared to be undamaged. The vines treated with *Systox* at 1 to 50 showed obvious evidence of chlorosis three to four weeks following treatment. There was some loss of foliage. All of the remaining vines in the *Systox* dilution series displayed only minor chlorotic symptoms.

Control of Scale on Ivy

English Ivy badly infested with scale (*Coccus hesperidum* L.) were dipped in January, 1953, in TEPP 40 per cent and malathion 57 per cent emulsions in dosage series of 1 to 100, 200, 400, and 800. Three plants in 2½-inch pots were used in each treatment. Control data were taken two weeks after dipping by examining all of the scales on nine leaves picked at random from the three plants in each test. A low power binocular microscope was used in determining scale mortality as shown in Table 7.

Both malathion and TEPP were efficient in controlling scale on Ivy. Malathion appeared to be only slightly superior to TEPP.

TABLE 7. CONTROL OF SCALE ON ENGLISH IVY

Material	Dilution	Control in 2 Weeks		Per Cent Control
		Dead	Alive	
Malathion				
57% emulsion	1-100	200	0	100
	1-200	369	0	100
	1-400	266	4[1]	98.5
	1-800	333	6[1]	98.2
TEPP				
40% emulsion	1-100	203	4[1]	98.0
	1-200	218	10[1]	95.6
	1-400	223	4[1]	98.2
	1-800	193	17[1]	91.9
Untreated		0	159	

[1]All adult females.

EUONYMUS SCALE

Life History

The Euonymus scale is a common and serious pest of different varieties of deciduous and evergreen Euonymus. It is also found on Pachysandra and bittersweet. When the insects are abundant they literally coat the leaves and stems of infested plants, resulting in serious weakening and sometimes the death of all or part of the plant. When climbing Euonymus are badly infested and portions die, the dead areas will prove very unsightly.

The female scale is about 1/16 of an inch long, flattened, slightly roughened, pear-shaped, and grayish-brown in color. The male scales are white, narrow, and easily seen. There are two broods a year in Connecticut. Overwintering occurs as a full-grown female. Eggs are deposited during the spring and begin to hatch in mid-June. By early July hatch is about complete. The young of the second brood appear during the later part of August and early September.

Control of this insect has not been easy. A 3 to 4 per cent dormant oil spray has controlled the scale when the treatment was applied in the spring before growth began. Unfortunately, however, this treatment caused the leaves to drop, resulting in bareness of the branches until the new growth developed.

Control Experiments

Most of the experimental work reported here in control of the Euonymus scale was carried on in a greenhouse during the winter of 1952 and 1953. A hundred flats each containing 48 4 to 8-inch rooted Euonymus cuttings, were used in one experiment. A count before treating showed the cuttings to have an average of 25 female and 276

Figure 3. Euonymus Scale on Euonymus

immature scales per 10 leaves. The female population on the stems was much heavier than on the leaves. A count indicated 30 to 35 per 1¼ to 1½ inches of stem. Many scales had not produced eggs at the time of treatment.

Some of the plants were treated with malathion 57 per cent emulsion at 1 to 100 and 1 to 200 and others at 1 to 400, 800, and 1600. Several plants were held as controls. A 3-gallon hand pressure sprayer was used to make the treatments, results of which are given in Table 8. Control data were taken several weeks after treatment by examining with the aid of a low power binocular microscope all of the scale on an average of six leaves per treatment.

Malathion gave complete control of the young scales at all dilutions. Most female scales were destroyed at the highest dilution. However, because of the poor showing of malathion at dilutions below 1 to 400, data were not taken at the two lowest concentrations. Malathion treatments did not injure euonymus plants.

TABLE 8. CONTROL OF EUONYMUS SCALE WITH MALATHION

Material	Dilution	Scale Mortality: Females dead	Females alive	Females per cent control	Young dead	Young alive	Young per cent control
Malathion							
57% emulsion	1-100	82	4	95.3	...	...	...
	1-200	12	21	36.3	49	0	100
	1-400	82	74	52.5	...	...	...
	1-800	..	..	...	181	0	100
	1-1600	..	..	...	400	0	100
Untreated		..	46	...	22	160	...

THE COTTONY TAXUS SCALE

Life History

The Cottony Taxus scale[1] *Pulvinaria floccifera* (W.) is a relative newcomer to Connecticut. It is reported as a tropical insect and greenhouse pest of Camellia, Abutilon and Acalyha. It was first reported in Connecticut in 1953 as a pest of several varieties of Taxus of both the erect-growing and spreading forms. It may have been in the State for a long while, but did not attack Taxus until recently.

The female scale passes the winter as a small, light brownish, flattened hemispherical scale about 1/8 inch long and in some respects not unlike overwintering *Lecanium* scales. Feeding is resumed in the spring. The scale matures rapidly, producing a long, flat, narrow, fluted, white, cottony-cushion egg mass extending back of the female about three to four times her length. Females drop off the plants as soon as they have laid their eggs[2]. Eggs hatch during June and the young infest the underside of Taxus leaves and sometimes the twigs of the previous year's growth. Very few, or none, are found on the upper surface of the foliage. One or two egg masses will sometimes cover the underside of a needle. When extremely abundant, the lower side of Taxus branches are literally coated white. Injury to the plants may be serious.

Control Experiments

Malathion 57 per cent emulsion used at the rate of 1 to 300 gave complete control of the scale when the treatment was made July 1. Dead scales averaged 136 per five 1½ inch Taxus twigs taken at random from the treated plants.

[1]As far as could be determined this scale had no common names. We propose the one which appears here.

[2]McDANIEL, E. I. Insects & Allied Pests of Plants Grown Under Glass. Mich. Agr. Exp. Sta. Sp. Bul. No. 214:117. 1931.

OYSTERSHELL SCALE

Life History

The Oystershell scale is a serious pest, attacking more than 100 varieties of deciduous trees and shrubs. It feeds on trunks, branches and twigs, and parts or all of the affected plants may die. Female scales are brownish-gray, about 1/8 inch long, and appear like tiny oyster shells. Feeding causes a drying-out, cracking and curling of the bark.

Figure 4. Oystershell Scale on Lilac

There is only one brood of the insect a year in the Northeast. Overwintering takes places in the egg stage, and hatching commences at the end of May. By June 3, 1953, counts showed that 54 per cent of the eggs under 222 scales had hatched.

Control Experiments

On June 6, when an estimated 95 per cent of the eggs had hatched on yellow wood (*Clawdastries lutia*) and 40 to 50 per cent on lilac (*Syringa vulgaris*), seven 5- to 7-foot trees of the former species and one 5-foot shrub of the latter were sprayed with malathion and *Potasan*

at the rate of 1 to 400 and 1 to 800. All treatments were replicated once and randomized. On June 12 one-half of the plants in the experiment were resprayed. Control data was secured from three 3-inch twig samples taken at random from each plant three weeks after the first series of treatments. Because of the enormous number of young scales on the treated plants, counts were made in 10 binocular microscope fields of 5.9 square millimeter area taken at random from each set of twig samples. Results indicated that one treatment of either of the two insecticides at the stated dilutions killed all scales. Scales that hatched subsequent to the first series of treatments did not survive the residual action of the insecticides.

PINE-LEAF SCALE

Life History

The Pine-leaf scale infests pines, spruces, firs, and Taxus species, but is injurious only to the first two varieties of trees. All age trees are attacked. Young trees, however, are more apt to die. Injury is confined to the needles.

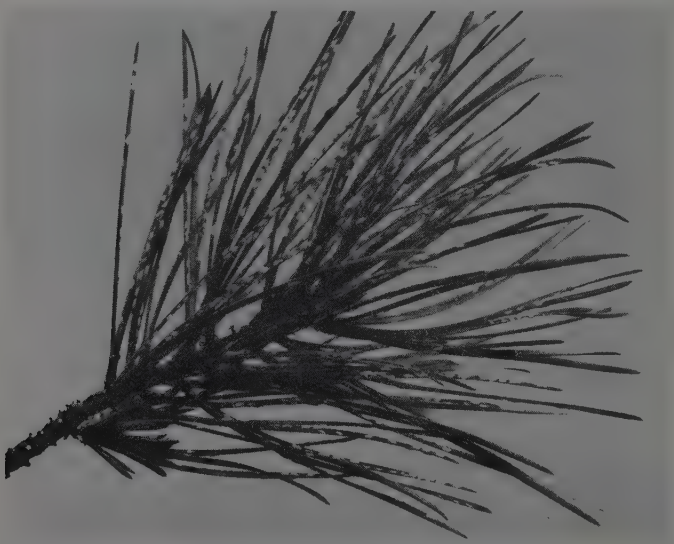

Figure 5. Pine-leaf Scale on Pitch Pine

Mature females of the Pine-leaf scale are white. The insect overwinters in the egg stage, and hatch begins about the middle of May. In 1953, 89 per cent of the egg masses showed an estimated 50 per cent

or greater hatch on May 19. On May 26 all but a few egg masses had hatched completely. The second brood of pine leaf scale began to hatch on July 20. By the close of the first week in August, all eggs had hatched and the young had dispersed.

Control Experiments

On May 27, malathion and parathion were sprayed on 3- to 5-foot *Pinus montana* (variety uncertain, perhaps *Mughus Zenari)* seriously infested with Pine-leaf scale at rates shown in Table 9. Because of the scarcity of plants, the treatments were not replicated or randomized. Information relative to control was secured from 10 needles taken at random from three 6-inch twigs per treatment. Counts of dispersed young were made 10 days after treatment by means of a binocular microscope. Owing to the good control obtained from the first treatments, no additional spraying was done. It was seen, however, that some of the young scales that hatched after treatment survived. This was more obvious in the parathion-sprayed plants. As a result, a fairly heavy second brood appeared on the parathion-treated plants at the two lowest dilutions. The malathion-sprayed plants were virtually free from infestation. The much lower count of dead scales on the parathion-treated plants resulted from dislodgment of the shriveled scales from the twig samples taken from these plants. The dead scales on the malathion-treated pines adhered longer.

Table 9. Control Of Pine-leaf Scale

Material	Rate of Treatment	No. of Dispersed Young		Per Cent Control
		Dead	Alive	
Malathion				
57% emulsion	1-800	447	10	97.8
	1-400	235	...	100
	1-200	520	...	100
Parathion				
25% emulsion	1-800	167	...	100
	1-400	63	5	92.6
	1-200	22	...	100
Untreated		45	250	....

AZALEA BARK SCALE

Life History

There is only one brood of the insect each year in Connecticut. Eggs commence hatching on or about June 20. Young migrants settle down in the axils of leaves or stems and along the main branches as far as the surface of the ground. Maturity is reached in the spring of the following year, at which time cottony or woolly masses form with eggs

deposited therein. Injury to *Azalea kaempferi* may be serious enough to kill parts or all of the plants affected. Foliage and twigs become covered with sooty fungus which grows in the honeydew secreted by the scales.

Control Experiments

The experiments reported here were carried on in 1951 and 1953. *Azalea kaempferi* 18 to 24 inches high were selected for treatment. In 1951 the first treatments were made on June 25, as indicated in Table 10. At this time egg hatch was not complete. Hence, a second series of treatments were made on July 9. Azaleas were sprayed only once in 1953 on August 6. Control data was obtained four weeks after treatment by counting all living and dead scales on three 3-inch twigs taken at random from treated and untreated plants. It would appear that the chlorinated hydrocarbon insecticides gave poor control of the scale, whereas the organic phosphates, thiocyanate and nicotine sulphate materials were by comparison highly efficient in this respect.

Table 10. Control Of Azalea Bark Scale

Material	Rate of Treatment	No. of Applications	No. of Scales		Per Cent Control
			Dead	Alive	
TEPP	1-800	2	372	0	100
20% emulsion	1-400	2	279	0	100
Nicotine	1-800	2	26	0	100
Sulphate 40%	1-400	2	13	0	100
Loro	1-800	2	176	0	100
40% emulsion	1-400	2	138	0	100
Lindane	1-800	2	24	11	68.5
25% emulsion	1-400	2	61	44	58.0
Chlordane	1-800	2	16	42	27.5
48% emulsion	1-400	2	16	121	11.6
Aldrin	1-800	2	38	149	20.3
21.85% emulsion	1-400	2	91	24	79.1
Dieldrin	1-800	2	29	129	18.3
15% emulsion	1-400	2	36	101	27.0
Potasan	1-800	1	514	0	100
30.6% emulsion	1-400	1	107	0	100
Malathion	1-800	1	454	0	100
57% emulsion	1-400	1	139	0	100
Untreated	....	.	...	484	....

MEALYBUGS

Life History

Mealybugs in general feed on so many varieties of plants and shrubs that it seems unnecessary to list all of them here. Coleus, palms, lantana, salvia, petunia, privet, larkspur, daisy, fruit trees, weeds, grape, chrysanthemums, narcissus bulbs, gladiolus, grasses and many deciduous hardwood trees and evergreens are a few of the plants injured by them. When mealybug infestation is serious, injury to the plants results through the removal by sucking of vital plant juices. Loss of color, wilting and ultimate death of part or all of the plant usually follows unless control is undertaken. Black sooty mold which grows in the honeydew secreted by the insects reduces the value of the plants.

Figure 6. Mealybug on *Taxus capatata*

In recent years Taxus has been seriously affected by a species of mealybug known as *Pseudococcus* which is closely related to *Comstocki*. There are two broods of the insect each year. The young of the first brood appears in July and those of the second brood in September. Overwintering takes place in the immature stage.

The long-tailed mealybug *Pseudococcus adonidum* (L) occurs both in the conservatory and out-of-doors. There are several broods or more a year especially where plants are grown continuously at high temperature and relative humidity.

Control Experiments

Experiments in control of mealybugs in the greenhouse were carried on using malathion 57 per cent emulsion in dosage series of 1 to 100, 200 and 400. Three- to 4-foot lemon and lantana plants were used in the treatments. Results of the treatments are given in Table 11.

Table 11. Control Of Mealy Bugs

Material	Dilution	Control			
		Dead		Alive	
		Young	Adults	Young	Adults
Malathion 57% emulsion	1-100	186	28	0	3
	1-200	180	15	0	2
	1-400	163	10	0	2
No treatment	....	...	..	184	17

Control of young mealybugs with malathion at all dilutions was complete, although a few adult females survived. No visible phytotoxicity developed.

A 5 per cent malathion dust applied to mealybug-infested *Taxus capatata* during late July and repeated two weeks later killed all of the first brood. Additional treatments during September were not necessary.

SUMMARY

The crawling stages, as well as the adults, of several species of scale insects discussed in this bulletin were controlled with the organic phosphate compounds TEPP, parathion, *Potasan, Systox, Pestox* and malathion. A thiocyanate, selenophosphate, nicotine sulphate and white summer oil preparation gave results equally as good.

The chlorinated hydrocarbon insecticides chlordane, aldrin, dieldrin, and lindane were for the most part poor in controlling scale insects. DDT was effective at high concentrations only.

Loro and *Loro* plus nicotine sulphate, malathion and parathion destroyed the eggs and the young of soft-bodied scales that had not crawled out from under the parent scale.

The systemic insecticides *Pestox, Systox* and selenophosphate used as soil treatments provided only average control of Camellia scale on

Camellia and soft brown scale on Stephanotis. The last two materials at high concentrations, however, gave good control of Lecanium scale on Taxus. *Potasan* used as a dip killed all scales on English ivy.

At high concentrations malathion destroyed adults of the Euonymus scale. None of the insecticides tested were tried on the armored stage of other hard-shelled species in the experiments, such as the Oystershell and Pine-leaf scales. These were controlled in the crawling stages or soon after the young had settled down for good. The crawling stages, as well as many of the adult, mealybugs were controlled with malathion.

Suggestions for Control

Malathion may be used to control all of the scale species listed in the foregoing pages. It is important, however, that the treatments be timed to destroy the crawling stages rather than the adult forms of most of them.

Malathion 57 per cent emulsion used at the rate of 2 to 3 pints per 100 gallons of water, or 2 to 3 teaspoons per gallon gave good control of Lecanium scale and the Cottony Taxus scale when the treatment was made during August, or before mid-May of the following year. A 50 per cent wettable powder used at the rate of 1 to 2 pounds per 100 gallons of water (2 to 4 teaspoons per gallon) or a 5 per cent dust may be substituted for the emulsion.

4 to 8 teaspoons per 1 gal.

Soft scale species occurring in the greenhouse or on house plants were controlled with malathion in the manner described above. Timing, however, was not so critical. Treatment was made when necessary by spraying or dipping the scale-infested plants. A second treatment several weeks after the first one may sometimes be needed.

Malathion at dilutions given above for control of Lecanium scale, etc., controlled the Oystershell scale when treatment was made June 15; the Pine-leaf scale when treatments were applied June 1 and August 15; the Azalea bark scale when treatment was made July 15, and the Euonymus scale when treatments were applied during the first week of July and repeated during early September.

Malathion 57 per cent emulsion used at the rate of 2 pints or more per 100 gallons of water gave good control of mealybugs on greenhouse plants. A 5 per cent malathion dust controlled the insects on Taxus.